What is claimed is:

1. A method for controlling admission of a new connection onto a transport link in a communication network, said method comprising the steps of:

- checking whether a multi-service traffic mix defined by previously admitted connections present on said link together with said new connection is contained within a non-linear admissible region;

- checking whether said traffic mix is contained also within at least one linear admissible region; and

- admitting said new connection for transport over said transport link only if said traffic mix is contained within an intersection of said at least one linear admissible region and said non-linear admissible region.

2. The method according to claim 1, wherein said admissible regions are related to respective quality of service (QoS) requirements.

3. The method according to claim 2, wherein said at least one linear admissible region contains a set of multi-service traffic mixes that fulfil a quality of service (QoS) requirement related to delay, and said non-linear admissible region contains a set of traffic mixes that fulfil a QoS requirement related to overload.

4. The method according to claim 1, wherein said non-linear admissible region is an overload-limited admissible region.

5. The method according to claim 4, wherein said overload-limited admissible region contains the set of traffic mixes for which the probability of temporarily overloading a queuing system associated with the transport link is smaller than a given target value.

6. The method according to claim 4, wherein said step of checking whether said traffic mix is contained within said non-linear overload-limited admissible region is

representative of checking whether or not said traffic mix violates a delay requirement related to packet loss caused by temporary overload of said transport link.

7. The method according to claim 4, wherein said step of checking whether said traffic mix is contained within said non-linear overload-limited admissible region comprises the step of evaluating the following inequalities:

$$\sum_{i=1}^{K} A_i \rho_i \leq C,$$

where K is the number of service classes in said traffic mix, A_i is a per-class limit on the number of simultaneously active connections, ρ_i is the average load generated by one active traffic source from class-i and C is the capacity of said transport link.

8. The method according to claim 7, wherein the per-class limit A_i is the number of connections from class-i such that the probability that more than A_i connections from class-i are active at the same time is smaller than a given target value.

9. The method according to claim 8, further comprising the steps of:

- pre-calculating at least some of said A_i values for a range of different values of the number N_i of connections from class-i or for a range of different activity factors α_i;
- storing said pre-calculated A_i values in memory; and
- accessing said pre-calculated A_i values from said memory for on-line evaluation of said inequalities.

10. The method according to claim 8, further comprising the step of determining A_i values by class-wise overload probability evaluation.

11. The method according to claim 10, wherein said step of determining A_i values comprises the step of finding minimal values of A_i such that the following sets of inequalities:

$$\sqrt[K_a]{1-\tilde{\varepsilon}_i^{lost}} \geq \frac{\sum_{n_i=0}^{A_i} n_i \prod_i (n_i)}{N_i \alpha_i},$$

$$\sqrt[K_a]{1-\tilde{\varepsilon}_i^{lost}} \geq \sum_{n_l=0}^{A_l} \prod_l (n_l) \qquad l = 1,2,\ldots,K_a, l \neq i,$$

are fulfilled, where K_a is the number of classes with activity factor α_i<1, $\tilde{\varepsilon}_i^{lost}$ is the target packet loss probability for service class-i approximated by the target overload probability assigned to class-i, N_i is the number of connections from class-i and n_i is the number of actually active connections from class-i.

12. The method according to claim 1, wherein said at least one linear admissible region is in the form of at least one delay-limited admissible region.

13. The method according to claim 12, wherein said at least one delay-limited admissible region is in the form of multiple class-specific delay-limited admissible regions.

14. The method according to claim 13, wherein each class-specific delay-limited admissible region is a linear admissible region that contains a set of traffic mixes fulfilling a given class-specific packet delay requirement.

15. The method according to claim 14, wherein said class-specific packet delay requirement requires that the probability of the class-specific packet delay being larger than a given class-specific maximum delay is smaller than a given target value.

16. The method according to claim 13, wherein said step of checking whether said traffic mix is contained also within multiple class-specific, delay-limited admissible regions comprises the step of evaluating the following inequalities:

$$\sum_{i=1}^{K} N_i \cdot TE_{ij} \leq TN_{jj} + \text{constant}, \quad j = 1, 2, \ldots, K,$$

where K is the number of service classes in said traffic mix, TN_{ij} is a representation of the maximum number of connections from class-i assuming that a packet from class-j would fulfil a packet delay requirement of class-j, TE_{ij} is a service class equivalent measure representing how many new connections can be admitted from class-j in place of a connection from class-i considering only the packet delay requirement of class-j and N_i is the number of connections from class-i in the traffic mix.

17. The method according to claim 16, wherein TE_{ij} is calculated in the following way:

$TE_{ij} = TN_{jj} / TN_{ij}$, and

TN_{ij} is calculated in the following way:

$$TN_{ij} = \max\left\{ N_i \,\middle|\, \sum_{n_i=0}^{N_i} \Pi(n_i) \; \Pr(D_j^{(i)} > \tilde{D}_j | n_i \text{ connections are active}) \leq \tilde{\varepsilon}_j^{delayed} \right\},$$

where $D_j^{(i)}$ denotes the delay of a packet from class-j assuming that the delay of the associated queue comes from only class-i connections, $\tilde{D}_j$ is the target delay criteria of packets from class-j, $\Pr(D_j^{(i)} > \tilde{D}_j | n_i \text{ connections are active})$ is the probability of packet delay criteria violation, $\tilde{\varepsilon}_j^{delayed}$ is the target value for the probability of a

packet exceeding its delay criteria without getting lost and n_i is the number of actually active connections from class-i.

18. The method according to claim 17, wherein the probability of packet delay criteria violation $\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active})$ is calculated in the following way:

$$\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active}) =$$
$$= \sum_{x'<l\le n_i} \binom{n_i}{l} \left(\frac{l-x'}{TTI'}\right)^l \left(1-\frac{l-x'}{TTI'}\right)^{n_i-l} \cdot \frac{TTI'-n_i+x'}{TTI'-l+x'}$$
$$x' = (\widetilde{D}_j - \frac{b_j}{C}) / TU$$
$$TTI' = TTI_i / TU$$
$$TU = \frac{b_i}{C},$$

where b_j is the class-j packet size, C is the capacity of said transport link and TTI_i is the relevant packet inter-arrival time.

19. The method according to claim 17, wherein the probability of packet delay criteria violation $\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active})$ is calculated in the following way:

$$\Pr(D_j^{(i)} > \widetilde{D}_j \mid n_i \text{ connections are active}) = \exp\left\{-\frac{2Cx}{TTI_i\, n_i\, \rho_i^2}\left(\frac{Cx}{TTI_i} + C - n_i\,\rho_i\right)\right\}$$
$$x = \widetilde{D}_j - \frac{b_j}{C},$$

where C is the capacity of said transport link, TTI_i is the relevant packet inter-arrival time, b_j is the class-j packet size and ρ_i is the average load generated by one active traffic source from class-i.

20. The method according to claim 16, wherein TE_{ij} is defined as $TE_{ij} = TN_{jj}/ TN_{ij}$, and TN_{ij} is calculated in the following way:

$$TN_{ij} = \left\lfloor \frac{C + \dfrac{C x \alpha_i}{TTI_i}}{\alpha_i \rho_i - \dfrac{\alpha_i \rho_i^2 \, TTI_i \ln(\tilde{\varepsilon}_j^{delayed})}{2x}} \right\rfloor$$

$$x = \tilde{D}_j - \frac{b_j}{C},$$

where C is the capacity of said transport link, α_i is the activity factor of class-i, TTI_i is the relevant packet inter-arrival time, ρ_i is the average load generated by one active traffic source from class-i, b_j is the class-j packet size and $\tilde{\varepsilon}_j^{delayed}$ is the target value for the probability of a packet exceeding its delay criteria without getting lost.

21. The method according to claim 16, further comprising the step of updating TN_{ij} and TE_{ij}, before said step of checking whether said traffic mix is contained within said intersection of admissible regions, only when said new connection belongs to a new service class.

22. The method according to claim 16, further comprising the step of assigning TN_{ij} a real value by means of interpolation.

23. The method according to claim 1, wherein said communication network is a transport network based on the Universal Terrestrial Radio Access Network (UTRAN).

24. A method for controlling admission of a new connection onto a transport link in a communication network, said method comprising the steps of:

- checking whether a multi-service traffic mix defined by previously admitted connections present on said link together with said new connection is contained within a non-linear overload-limited admissible region; and
- admitting said new connection for transport over said transport link only if said traffic mix is contained within said non-linear overload-limited admissible region.

25. A method for controlling admission of a new connection onto a transport link in a communication network, said method comprising the steps of:

- checking whether a multi-service traffic mix defined by previously admitted connections present on said link together with said new connection is contained within an intersection of multiple service-class-specific delay-limited admissible regions; and
- admitting said new connection for transport over said transport link only if said traffic mix is contained within said intersection of admissible regions.

26. An admission controller for controlling admission of a new connection onto a transport link in a communication network, said admission controller comprising:

- means for checking whether a multi-service traffic mix defined by previously admitted connections present on said link together with said new connection is contained within a non-linear admissible region;
- means for checking whether said traffic mix is contained also within at least one linear admissible region; and
- means for admitting said new connection for transport over said transport link only if said traffic mix is contained within an intersection of said at least one linear admissible region and said non-linear admissible region.

27. The admission controller according to claim 26, wherein said admissible regions are related to respective quality of service (QoS) requirements.

28. The admission controller according to claim 27, wherein said at least one linear admissible region contains a set of multi-service traffic mixes that fulfil a quality of service (QoS) requirement related to delay, and said non-linear admissible region contains a set of traffic mixes that fulfil a QoS requirement related to overload.

29. The admission controller according to claim 26, wherein said non-linear admissible region is an overload-limited admissible region.

30. The admission controller according to claim 29, wherein said overload-limited admissible region contains the set of traffic mixes for which the probability of temporarily overloading a queuing system associated with the transport link is smaller than a given target value.

31. The admission controller according to claim 29, wherein said means for checking whether said traffic mix is contained within said non-linear overload-limited admissible region is operable for checking whether said traffic mix violates a packet delay requirement related to packet loss caused by temporary overload of said transport link.

32. The admission controller according to claim 29, wherein said means for checking whether said traffic mix is contained within said non-linear overload-limited admissible region comprises means for evaluating the following inequalities:

$$\sum_{i=1}^{K} A_i \rho_i \leq C,$$

where K is the number of service classes in said traffic mix, A_i is a per-class limit on the number of simultaneously active connections, ρ_i is the average load generated by one active traffic source from class-i and C is the capacity of said transport link.

33. The admission controller according to claim 32, wherein the per-class limit A_i is the number of connections from class-i such that the probability that more than A_i connections from class-i are active at the same time is smaller than a given target value.

34. The admission controller according to claim 33, further comprising:

- means for pre-calculating at least some of said A_i values for a range of different values of the number N_i of connections from class-i or for a range of different activity factors α_i;
- means for storing said pre-calculated A_i values in memory; and
- means for accessing said pre-calculated A_i values from said memory for on-line evaluation of said inequalities.

35. The admission controller according to claim 33, further comprising means for determining A_i values by class-wise overload probability evaluation.

36. The admission controller according to claim 35, wherein said means for determining A_i values comprises means for finding minimal values of A_i such that the following sets of inequalities:

$$\sqrt[K_a]{1-\tilde{\varepsilon}_i^{lost}} \geq \frac{\sum_{n_i=0}^{A_i} n_i \prod_i (n_i)}{N_i \alpha_i},$$

$$\sqrt[K_a]{1-\tilde{\varepsilon}_i^{lost}} \geq \sum_{n_l=0}^{A_l} \prod_l (n_l) \qquad l = 1,2,\ldots,K_a, l \neq i,$$

are fulfilled, where K_a is the number of service classes with activity factor α_i<1, $\tilde{\varepsilon}_i^{lost}$ is the target packet loss probability for service class-i approximated by the target overload probability assigned to class-i, N_i is the number of connections from class-i and n_i is the number of actually active connections from class-i.

37. The admission controller according to claim 26, wherein said at least one linear admissible region is in the form of at least one delay-limited admissible region.

38. The admission controller according to claim 37, wherein said at least one delay-limited admissible region is in the form of multiple class-specific delay-limited admissible regions.

39. The admission controller according to claim 38, wherein each class-specific delay-limited admissible region is a linear admissible region that contains a set of traffic mixes fulfilling a given class-specific packet delay requirement.

40. The admission controller according to claim 39, wherein said class-specific packet delay requirement requires that the probability of the class-specific packet delay being larger than a given class-specific maximum delay is smaller than a given target value.

41. The admission controller according to claim 38, wherein said means for checking whether said traffic mix is contained also within multiple class-specific, delay-limited admissible regions comprises means for evaluating the following inequalities:

$$\sum_{i=1}^{K} N_i \cdot TE_{ij} \leq TN_{jj} + \text{constant}, \; j = 1, 2, \ldots, K,$$

where K is the number of service classes in said traffic mix, TN_{ij} is a representation of the maximum number of connections from class-i assuming that a packet from class-j

would fulfil a packet delay requirement of class-j, TE_{ij} is a service class equivalent measure representing how many new connections can be admitted from class-j in place of a connection from class-i considering only the packet delay requirement of class-j and N_i is the number of connections from class-i in the traffic mix.

42. The admission controller according to claim 41, wherein said means for checking whether said traffic mix is contained also within multiple class-specific, delay-limited admissible regions comprises:

- means for calculating TE_{ij} in the following way:

$$TE_{ij} = TN_{jj} / TN_{ij}; \text{ and}$$

- means for calculating TN_{ij} in the following way:

$$TN_{ij} = \max\left\{ N_i \,\middle|\, \sum_{n_i=0}^{N_i} \Pi(n_i)\ \Pr\left(D_j^{(i)} > \tilde{D}_j \middle| n_i \text{ connections are active}\right) \le \tilde{\varepsilon}_j^{delayed} \right\},$$

where $D_j^{(i)}$ denotes the delay of a packet from class-j assuming that the delay of the associated queue comes from only class-i connections, $\tilde{D}_j$ is the target delay criteria of packets from class-j, $\Pr(D_j^{(i)} > \tilde{D}_j | n_i \text{ connections are active})$ is the probability of packet delay criteria violation, $\tilde{\varepsilon}_j^{delayed}$ is the target value for the probability of a packet exceeding its delay criteria without getting lost and n_i is the number of actually active connections from class-i.

43. The admission controller according to claim 42, wherein said means for calculating TN_{ij} comprises means for calculating the probability of packet delay criteria violation $\Pr(D_j^{(i)} > \tilde{D}_j | n_i \text{ connections are active})$ in the following way:

$$\Pr(D_j^{(i)} > \tilde{D}_j | n_i \text{ connections are active}) =$$
$$= \sum_{x'<l\leq n_i} \binom{n_i}{l} \left(\frac{l-x'}{TTI'}\right)^l \left(1-\frac{l-x'}{TTI'}\right)^{n_i-l} \cdot \frac{TTI'-n_i+x'}{TTI'-l+x'}$$

$$x' = (\tilde{D}_j - \frac{b_j}{C}) / TU$$

$$TTI' = TTI_i / TU$$

$$TU = \frac{b_i}{C},$$

where b_j is the class-j packet size, C is the capacity of said transport link and TTI_i is the relevant packet inter-arrival time.

44. The admission controller according to claim 42, wherein said means for calculating TN_{ij} comprises means for calculating the probability of packet delay criteria violation $\Pr(D_j^{(i)} > \tilde{D}_j | n_i \text{ connections are active})$ in the following way:

$$\Pr(D_j^{(i)} > \tilde{D}_j \,|\, n_i \text{ connections are active}) = \exp\left\{-\frac{2Cx}{TTI_i\, n_i\, \rho_i^2}\left(\frac{Cx}{TTI_i} + C - n_i\,\rho_i\right)\right\}$$

$$x = \tilde{D}_j - \frac{b_j}{C},$$

where C is the capacity of said transport link, TTI_i is the relevant packet inter-arrival time, b_j is the class-j packet size and ρ_i is the average load generated by one active traffic source from class-i.

45. The admission controller according to claim 41, wherein said means for checking whether said traffic mix is contained also within multiple class-specific, delay-limited admissible regions comprises:

- means for calculating TE_{ij} in the following way:

$$TE_{ij} = TN_{jj} / TN_{ij}; \text{ and}$$

- means for calculating TN_{ij} in the following way:

$$TN_{ij} = \left\lfloor \frac{C + \dfrac{C x \alpha_i}{TTI_i}}{\alpha_i \rho_i - \dfrac{\alpha_i \rho_i^2 \, TTI_i \ln(\tilde{\varepsilon}_j^{delayed})}{2x}} \right\rfloor$$

$$x = \tilde{D}_j - \frac{b_j}{C},$$

where C is the capacity of said transport link, α_i is the activity factor of class-i, TTI_i is the relevant packet inter-arrival time, ρ_i is the average load generated by one active traffic source from class-i, b_j is the class-j packet size and $\tilde{\varepsilon}_j^{delayed}$ is the target value for the probability of a packet exceeding its delay criteria without getting lost.

46. The admission controller according to claim 41, further comprising means for updating TN_{ij} and TE_{ij}, before checking whether said traffic mix is contained within said intersection of admissible regions, when said new connection belongs to a new service class.

47. The admission controller according to claim 41, further comprising means for assigning TN_{ij} a real value by means of interpolation.

48. The admission controller according to claim 26, wherein said communication network is a transport network based on the Universal Terrestrial Radio Access Network (UTRAN).

49. An admission controller for controlling admission of a new connection onto a transport link in a communication network, said admission controller comprising:

- means for checking whether a multi-service traffic mix defined by previously admitted connections present on said link together with said new connection is contained within a non-linear overload-limited admissible region; and
- means for admitting said new connection for transport over said transport link only if said traffic mix is contained within said non-linear overload-limited admissible region.

50. An admission controller for controlling admission of a new connection onto a transport link in a communication network, said admission controller comprising:

- means for checking whether a multi-service traffic mix defined by previously admitted connections present on said link together with said new connection is contained within an intersection of multiple service-class-specific delay-limited admissible regions; and
- means for admitting said new connection for transport over said transport link only if said traffic mix is contained within said intersection of admissible regions.

AMENDED CLAIMS

[received by the International Bureau on 24 February 2003 (24.02.03); original claims 1-50 replaced by new claims 1-42]

1. A method for controlling admission of a new connection onto a transport link in a communication network, said method comprising the steps of:

- checking whether a multi-service-class traffic mix defined by previously admitted connections present on said link together with said new connection is contained within an overload-limited admissible region defined as a non-lincar admissible region that contains a set of traffic mixes that fulfil a given overload requirement, where the dimensions of said non-linear admissible region are the number of connections in the respective service classes;

- checking, for each of a number of said service classes, whether said traffic mix is contained also within a class-specific delay-limited admissible region approximated as a linear admissible region that contains a set of traffic mixes that fulfil a given class-specific delay requirement, where the dimensions of said linear admissible region are the number of connections in the respective service classes; and

- admitting said new connection for transport over said transport link only if said traffic mix is contained within an intersection of said non-linear overload-limited admissible region and said linear delay-limited admissible region(s).

2. The method according to claim 1, wherein said delay-limited region is approximated as a linear region for a multi-service-class traffic mix generally modeled as a superposition of periodic on-off connections.

3. The method according to claim 1, wherein said overload-limited admissible region contains the set of traffic mixes for which the probability of temporarily overloading a queuing system associated with the transport link is smaller than a given target value.

4. The method according to claim 1, wherein said step of checking whether said traffic mix is contained within said non-linear overload-limited admissible region is

representative of checking whether or not said traffic mix violates a delay requirement related to packet loss caused by temporary overload of said transport link.

5. The method according to claim 1, wherein said step of checking whether said traffic mix is contained within said non-linear overload-limited admissible region comprises the step of evaluating the following inequalities:

$$\sum_{i=1}^{K} A_i \rho_i \leq C,$$

where K is the number of service classes in said traffic mix, A_i is a per-class limit on the number of simultaneously active connections, ρ_i is the average load generated by one active traffic source from class-i and C is the capacity of said transport link.

6. The method according to claim 5, wherein the per-class limit A_i is the number of connections from class-i such that the probability that more than A_i connections from class-i are active at the same time is smaller than a given target value.

7. The method according to claim 6, further comprising the steps of:

- pre-calculating at least some of said A_i values for a range of different values of the number N_i of connections from class-i or for a range of different activity factors α_i;
- storing said pre-calculated A_i values in memory; and
- accessing said pre-calculated A_i values from said memory for on-line evaluation of said inequalities.

8. The method according to claim 6, further comprising the step of determining A_i values by class-wise overload probability evaluation.

9. The method according to claim 8, wherein said step of determining A_i values comprises the step of finding values of A_i such that the following sets of inequalities:

$$\sqrt[K_a]{1-\tilde{\varepsilon}_i^{lost}} \geq \frac{\sum_{n_i=0}^{A_i} n_i \prod_i (n_i)}{N_i \alpha_i},$$

$$\sqrt[K_a]{1-\tilde{\varepsilon}_i^{lost}} \geq \sum_{n_l=0}^{A_l} \prod_l (n_l) \qquad l=1,2,\ldots,K_a, l \neq i,$$

are fulfilled, where K_a is the number of classes with activity factor α_i<1, $\tilde{\varepsilon}_i^{lost}$ is the target packet loss probability for service class-i approximated by the target overload probability assigned to class-i, N_i is the number of connections from class-i and n_i is the number of actually active connections from class-i.

10. The method according to claim 1, wherein said class-specific packet delay requirement requires that the probability of the class-specific packet delay being larger than a given class-specific maximum delay is smaller than a given target value.

11. The method according to claim 1, comprising the step of checking whether said traffic mix is contained within multiple class-specific, delay-limited admissible regions by evaluating the following inequalities:

$$\sum_{i=1}^{K} N_i \cdot TE_{ij} \leq TN_{jj} + \text{constant}, \quad j = 1, 2, \ldots, K,$$

where K is the number of service classes in said traffic mix, TN_{ij} is a representation of the maximum number of connections from class-i assuming that a packet from class-j would fulfil a packet delay requirement of class-j, TE_{ij} is a service class equivalent measure representing how many new connections can be admitted from class-j in place of a connection from class-i considering only the packet delay requirement of class-j and N_i is the number of connections from class-i in the traffic mix.

12. The method according to claim 11, wherein TE_{ij} is calculated in the following way:

$$TE_{ij} = TN_{jj} / TN_{ij}, \text{ and}$$

TN_{ij} is calculated in the following way:

$$TN_{ij} = \max\left\{ N_i \,\middle|\, \sum_{n_i=0}^{N_i} \Pi(n_i)\ \Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active}) \le \widetilde{\varepsilon}_j^{delayed} \right\},$$

where $D_j^{(i)}$ denotes the delay of a packet from class-j assuming that the delay of the associated queue comes from only class-i connections, $\widetilde{D}_j$ is the target delay criteria of packets from class-j, $\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active})$ is the probability of packet delay criteria violation, $\widetilde{\varepsilon}_j^{delayed}$ is the target value for the probability of a packet exceeding its delay criteria without getting lost and n_i is the number of actually active connections from class-i.

13. The method according to claim 12, wherein the probability of packet delay criteria violation $\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active})$ is calculated in the following way:

$$\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active}) =$$

$$= \sum_{x' < l \le n_i} \binom{n_i}{l} \left(\frac{l - x'}{TTI'}\right)^l \left(1 - \frac{l - x'}{TTI'}\right)^{n_i - l} \cdot \frac{TTI' - n_i + x'}{TTI' - l + x'}$$

$$x' = (\widetilde{D}_j - \frac{b_j}{C}) / TU$$

$$TTI' = TTI_i / TU$$

$$TU = \frac{b_i}{C},$$

where b_j is the class-j packet size, C is the capacity of said transport link and TTI_i is the relevant packet inter-arrival time.

14. The method according to claim 12, wherein the probability of packet delay criteria violation $\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active})$ is calculated in the following way:

$$\Pr(D_j^{(i)} > \widetilde{D}_j \mid n_i \text{ connections are active}) = \exp\left\{-\frac{2Cx}{TTI_i\, n_i\, \rho_i^2}\left(\frac{Cx}{TTI_i} + C - n_i\,\rho_i\right)\right\}$$

$$x = \widetilde{D}_j - \frac{b_j}{C},$$

where C is the capacity of said transport link, TTI_i is the relevant packet inter-arrival time, b_j is the class-j packet size and ρ_i is the average load generated by one active traffic source from class-i.

15. The method according to claim 11, wherein TE_{ij} is defined as $TE_{ij} = TN_{jj}/\ TN_{ij}$, and TN_{ij} is calculated in the following way:

$$TN_{ij} = \left\lfloor \frac{C + \dfrac{Cx\alpha_i}{TTI_i}}{\alpha_i\,\rho_i - \dfrac{\alpha_i\,\rho_i^2\, TTI_i \ln(\widetilde{\varepsilon}_j^{delayed})}{2x}} \right\rfloor$$

$$x = \widetilde{D}_j - \frac{b_j}{C},$$

where C is the capacity of said transport link, α_i is the activity factor of class-i, TTI_i is the relevant packet inter-arrival time, ρ_i is the average load generated by one active traffic source from class-i, b_j is the class-j packet size and $\tilde{\varepsilon}_j^{delayed}$ is the target value for the probability of a packet exceeding its delay criteria without getting lost.

16. The method according to claim 11, further comprising the step of updating TN_{ij} and TE_{ij}, before said step of checking whether said traffic mix is contained within said intersection of admissible regions, only when said new connection belongs to a new service class.

17. The method according to claim 11, further comprising the step of assigning TN_{ij} a real value by means of interpolation.

18. The method according to claim 12, wherein, if class-i packets have higher priority than class-j packets, the probability of packet delay criteria violation is calculated in the following way:

$$\Pr\left(B^{(i)}(0,\widetilde{D}_j - \frac{s_{last}}{C}) < \frac{b_j - s_{last}}{C}\right),$$

where $B^{(i)}(0, t)$ denotes the server availability in $[0, t]$ seen by the class-j packet arriving at time 0, s_{last} denotes the size of the last segment of the class-j packet, and b_j is the class-j packet size.

19. The method according to claim 1, wherein said communication network is a transport network based on the Universal Terrestrial Radio Access Network (UTRAN).

20. A method for controlling admission of a new connection onto a transport link in a communication network, said method comprising the steps of:

- checking whether a multi-service traffic mix defined by previously admitted connections present on said link together with said new connection is contained within a non-linear overload-limited admissible region by evaluating the following inequalities:

$$\sum_{i=1}^{K} A_i \rho_i \leq C,$$

where K is the number of service classes in said traffic mix, A_i is a per-class limit on the number of simultaneously active connections, ρ_i is the average load generated by one active traffic source from class-i and C is the capacity of said transport link; and

- admitting said new connection for transport over said transport link only if said traffic mix is contained within said non-linear overload-limited admissible region.

21. A method for controlling admission of a new connection onto a transport link in a communication network, said method comprising the steps of:

- checking whether a multi-service traffic mix defined by previously admitted connections present on said link together with said new connection is contained within an intersection of multiple service-class-specific delay-limited admissible regions by evaluating the following inequalities:

$$\sum_{i=1}^{K} N_i \cdot TE_{ij} \leq TN_{jj} + \text{constant}, \quad j = 1, 2, \ldots, K,$$

where K is the number of service classes in said traffic mix, TN_{ij} is a representation of the maximum number of connections from class-i assuming that a packet from class-j would fulfil a packet delay requirement of class-j, TE_{ij} is a service class equivalent

measure representing how many new connections can be admitted from class-j in place of a connection from class-i considering only the packet delay requirement of class-j and N_i is the number of connections from class-i in the traffic mix; and

- admitting said new connection for transport over said transport link only if said traffic mix is contained within said intersection of admissible regions.

22. An admission controller for controlling admission of a new connection onto a transport link in a communication network, said admission controller comprising:

- means for checking whether a multi-service-class traffic mix defined by previously admitted connections present on said link together with said new connection is contained within an overload-limited admissible region defined as a non-linear admissible region that contains a set of traffic mixes that fulfil a given overload requirement, where the dimensions of said non-linear admissible region are the number of connections in the respective service classes;
- means for checking, for each of a number of said service classes, whether said traffic mix is contained also within a class-specific delay-limited admissible region approximated as a linear admissible region that contains a set of traffic mixes that fulfil a given class-specific delay requirement, where the dimensions of said linear admissible region are the number of connections in the respective service classes; and
- means for admitting said new connection for transport over said transport link only if said traffic mix is contained within an intersection of said non-linear overload-limited admissible region and said linear delay-limited admissible region(s).

23. The admission controller according to claim 22, wherein said delay-limited region is approximated as a linear region for a multi-service-class traffic mix generally modeled as a superposition of periodic on-off connections.

24. The admission controller according to claim 22, wherein said overload-limited admissible region contains the set of traffic mixes for which the probability of

temporarily overloading a queuing system associated with the transport link is smaller than a given target value.

25. The admission controller according to claim 22, wherein said means for checking whether said traffic mix is contained within said non-linear overload-limited admissible region is operable for checking whether said traffic mix violates a packet delay requirement related to packet loss caused by temporary overload of said transport link.

26. The admission controller according to claim 22, wherein said means for checking whether said traffic mix is contained within said non-linear overload-limited admissible region comprises means for evaluating the following inequalities:

$$\sum_{i=1}^{K} A_i \rho_i \leq C,$$

where K is the number of service classes in said traffic mix, A_i is a per-class limit on the number of simultaneously active connections, ρ_i is the average load generated by one active traffic source from class-i and C is the capacity of said transport link.

27. The admission controller according to claim 26, wherein the per-class limit A_i is the number of connections from class-i such that the probability that more than A_i connections from class-i are active at the same time is smaller than a given target value.

28. The admission controller according to claim 27, further comprising:

- means for pre-calculating at least some of said A_i values for a range of different values of the number N_i of connections from class-i or for a range of different activity factors α_i;
- means for storing said pre-calculated A_i values in memory; and

- means for accessing said pre-calculated A_i values from said memory for on-line evaluation of said inequalities.

29. The admission controller according to claim 27, further comprising means for determining A_i values by class-wise overload probability evaluation.

30. The admission controller according to claim 29, wherein said means for determining A_i values comprises means for finding values of A_i such that the following sets of inequalities:

$$\sqrt[K_a]{1-\tilde{\varepsilon}_i^{lost}} \geq \frac{\sum_{n_i=0}^{A_i} n_i \prod_i(n_i)}{N_i \alpha_i},$$

$$\sqrt[K_a]{1-\tilde{\varepsilon}_i^{lost}} \geq \sum_{n_l=0}^{A_l} \prod_l(n_l) \qquad l=1,2,\ldots,K_a, l \neq i,$$

are fulfilled, where K_a is the number of service classes with activity factor α_i<1, $\tilde{\varepsilon}_i^{lost}$ is the target packet loss probability for service class-i approximated by the target overload probability assigned to class-i, N_i is the number of connections from class-i and n_i is the number of actually active connections from class-i.

31. The admission controller according to claim 22, wherein said class-specific packet delay requirement requires that the probability of the class-specific packet delay being larger than a given class-specific maximum delay is smaller than a given target value.

32. The admission controller according to claim 22, comprising means for checking whether said traffic mix is contained within multiple class-specific, delay-limited admissible regions based on evaluation of the following inequalities:

$$\sum_{i=1}^{K} N_i \cdot TE_{ij} \le TN_{jj} + \text{constant},\ j = 1, 2, \ldots, K,$$

where K is the number of service classes in said traffic mix, TN_{ij} is a representation of the maximum number of connections from class-i assuming that a packet from class-j would fulfil a packet delay requirement of class-j, TE_{ij} is a service class equivalent measure representing how many new connections can be admitted from class-j in place of a connection from class-i considering only the packet delay requirement of class-j and N_i is the number of connections from class-i in the traffic mix.

33. The admission controller according to claim 32, wherein said means for checking whether said traffic mix is contained within multiple class-specific, delay-limited admissible regions comprises:

- means for calculating TE_{ij} in the following way:

$TE_{ij} = TN_{jj} / TN_{ij}$; and

- means for calculating TN_{ij} in the following way:

$$TN_{ij} = \max\left\{ N_i \,\middle|\, \sum_{n_i=0}^{N_i} \Pi(n_i)\ \Pr\left(D_j^{(i)} > \widetilde{D}_j \middle| n_i \text{ connections are active}\right) \le \widetilde{\varepsilon}_j^{\,delayed} \right\},$$

where $D_j^{(i)}$ denotes the delay of a packet from class-j assuming that the delay of the associated queue comes from only class-i connections, $\widetilde{D}_j$ is the target delay criteria of packets from class-j, $\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active})$ is the probability of packet delay criteria violation, $\widetilde{\varepsilon}_j^{\,delayed}$ is the target value for the probability of a packet exceeding its delay criteria without getting lost and n_i is the number of actually active connections from class-i.

34. The admission controller according to claim 33, wherein said means for calculating TN_{ij} comprises means for calculating the probability of packet delay criteria violation $\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active})$ in the following way:

$$\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active}) =$$

$$= \sum_{x' < l \le n_i} \binom{n_i}{l} \left(\frac{l - x'}{TTI'}\right)^l \left(1 - \frac{l - x'}{TTI'}\right)^{n_i - l} \cdot \frac{TTI' - n_i + x'}{TTI' - l + x'}$$

$$x' = (\widetilde{D}_j - \frac{b_j}{C}) / TU$$

$$TTI' = TTI_i / TU$$

$$TU = \frac{b_i}{C},$$

where b_j is the class-j packet size, C is the capacity of said transport link and TTI_i is the relevant packet inter-arrival time.

35. The admission controller according to claim 33, wherein said means for calculating TN_{ij} comprises means for calculating the probability of packet delay criteria violation $\Pr(D_j^{(i)} > \widetilde{D}_j | n_i \text{ connections are active})$ in the following way:

$$\Pr(D_j^{(i)} > \widetilde{D}_j \,|\, n_i \text{ connections are active}) = \exp\left\{-\frac{2Cx}{TTI_i n_i \rho_i^2}\left(\frac{Cx}{TTI_i} + C - n_i \rho_i\right)\right\}$$

$$x = \widetilde{D}_j - \frac{b_j}{C},$$

where C is the capacity of said transport link, TTI_i is the relevant packet inter-arrival time, b_j is the class-j packet size and ρ_i is the average load generated by one active traffic source from class-i.

36. The admission controller according to claim 32, wherein said means for checking whether said traffic mix is contained also within multiple class-specific, delay-limited admissible regions comprises:

- means for calculating TE_{ij} in the following way:

$TE_{ij} = TN_{jj} / TN_{ij}$; and

- means for calculating TN_{ij} in the following way:

$$TN_{ij} = \left\lfloor \frac{C + \frac{C x \alpha_i}{TTI_i}}{\alpha_i \rho_i - \frac{\alpha_i \rho_i^2 \, TTI_i \ln(\tilde{\varepsilon}_j^{delayed})}{2x}} \right\rfloor$$

$$x = \tilde{D}_j - \frac{b_j}{C},$$

where C is the capacity of said transport link, α_i is the activity factor of class-i, TTI_i is the relevant packet inter-arrival time, ρ_i is the average load generated by one active traffic source from class-i, b_j is the class-j packet size and $\tilde{\varepsilon}_j^{delayed}$ is the target value for the probability of a packet exceeding its delay criteria without getting lost.

37. The admission controller according to claim 32, further comprising means for updating TN_{ij} and TE_{ij}, before checking whether said traffic mix is contained within said intersection of admissible regions, when said new connection belongs to a new service class.

38. The admission controller according to claim 32, further comprising means for assigning TN_{ij} a real value by means of interpolation.

39. The admission controller according to claim 33, wherein, if class-i packets have higher priority than class-j packets, the probability of packet delay criteria violation is calculated in the following way:

$$\Pr\left(B^{(i)}(0,\widetilde{D}_j - \frac{s_{last}}{C}) < \frac{b_j - s_{last}}{C}\right),$$

where $B^{(i)}(0, t)$ denotes the server availability in $[0, t]$ seen by the class-j packet arriving at time 0, s_{last} denotes the size of the last segment of the class-j packet, and b_j is the class-j packet size.

40. The admission controller according to claim 22, wherein said communication network is a transport network based on the Universal Terrestrial Radio Access Network (UTRAN).

41. An admission controller for controlling admission of a new connection onto a transport link in a communication network, said admission controller comprising:

- means for checking whether a multi-service traffic mix defined by previously admitted connections present on said link together with said new connection is contained within a non-linear overload-limited admissible region based on evaluation of the following inequalities:

$$\sum_{i=1}^{K} A_i \rho_i \le C,$$

where K is the number of service classes in said traffic mix, A_i is a per-class limit on the number of simultaneously active connections, ρ_i is the average load generated by one active traffic source from class-i and C is the capacity of said transport link; and

- means for admitting said new connection for transport over said transport link only if said traffic mix is contained within said non-linear overload-limited admissible region.

42. An admission controller for controlling admission of a new connection onto a transport link in a communication network, said admission controller comprising:

- means for checking whether a multi-service traffic mix defined by previously admitted connections present on said link together with said new connection is contained within an intersection of multiple service-class-specific delay-limited admissible regions based on evaluation of the following inequalities:

$$\sum_{i=1}^{K} N_i \cdot TE_{ij} \leq TN_{jj} + \text{constant},\ \ j = 1, 2, \ldots, K,$$

where K is the number of service classes in said traffic mix, TN_{ij} is a representation of the maximum number of connections from class-i assuming that a packet from class-j would fulfil a packet delay requirement of class-j, TE_{ij} is a service class equivalent measure representing how many new connections can be admitted from class-j in place of a connection from class-i considering only the packet delay requirement of class-j and N_i is the number of connections from class-i in the traffic mix; and

- means for admitting said new connection for transport over said transport link only if said traffic mix is contained within said intersection of admissible regions.
